University POLITEHNICA of Bucharest
Faculty of Electronics, Telecommunications and Information Technology

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	University POLITEHNICA of Bucharest
1.2 Faculty	Electronics, Telecommunications and Information Technology
1.3 Department	Dept. of Electronic Devices, Circuits and Architectures
1.4 Domain of studies	Electronics, Telecommunications and Information Technologies, Computers and Information Technology
1.5 Cycle of studies	Bachelor (engineering)
1.6 Program of studies/Qualification	All

2. Course identification information

2.1 Name of the course				Microcontrollers			
2.2 Lecturer				Prof. Corneliu Burileanu			
2.3 Instructor for practical activities				Asist. Diana Şandru			
2.4 Year of studies	III	2.5 Semester	I	2.6 Evaluation type	Exam	2.7 Course choice type	Compulsory

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week, out of which	3	3.2 course	2	3.3 practical activities	1
3.4 Total hours in the curricula, out of which	42	3.5 course	28	3.6 practical activities	14

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	14
Supplemental documentation (library, electronic access resources, in the field, etc)	14
Preparation for practical activities, homeworks, essays, portfolios, etc.	14
Tutoring	0
Examinations	3
Other activities	0

3.7 Total hours of individual study	42
3.9 Total hours per semester	84
3. 10 Number of ECTS credit points	3

4. Prerequisites (if applicable)

4.1 curricular	Computer programming Data structures and Algorithms Microprocessor Architecture
4.2 competence-based	Applying knowledge about the basic concepts and methods of computer systems architecture, programming languages and techniques

5. Requisites (if applicable)

5.1 for running the course	Room equipped with a video projector
5.2 for running of the applications	Room equipped with computers and specific software. Compulsory presence at laboratory classes, according to current PUB regulations.

6. Specific competences

Professional competences	C2. Design of hardware, software and telecommunication systems C2.1 Description of the structure and of the architecture for hardware, software and telecommunication systems C2.2 Explaining the purpose and the operation details for hardware, software and telecommunication systems C4. Using programming technologies and environments
Transversal competences	Honorable, responsible and ethical behavior to ensure the reputation of the profession. Awareness of the need for continuous training; efficient use of resources and learning techniques for personal and professional development.

7. Course objectives (as implied by the grid of specific competences)

7.1 General objective of the course	Introducing several typical microcontroller architectures: 8051 core, "Arduino" Systems and ARM family. Study of the advanced principles in CISC and RISC microprocessor architecture: memory management, protected mode, multitasking, CISC and RISC architecture convergence in actual processors.
7.2 Specific objectives	During the laboratories the architecture attributes for the 8051-core microcontroller family are pointed out. The students are involved in both software and hardware applications using 8051 microcontrollers.

8. Content

8.1 Lectures	Teaching techniques	Remarks
1. 8051 Microcontroller Core 1.1. General Features	The lectures are presented in a	4 hrs

1.2. Memory Organization 1.3. Register Set 1.4. Addressing Techniques 1.5. Instruction Set 1.6. Instruction Timing	multimedia amphitheatre of the faculty. The lecture slides are available online on the faculty's "Moodle" platform.	
2. Arduino Systems 2.1. Arduino Uno 2.2. ATmega48A/PA/88A/PA/168A/PA/328/P 2.3. AVR CPU Core 2.4. GALILEO Board 2.5. Programming Examples		4 hrs
3. ARM Architecture Microcontrollers 3.1. General features 3.2. Processor Modes 3.3. Register Set 3.4. Memory and Port Organization 3.5. Instruction Set 3.6. Programming Examples		4 hrs
4. Memory Management 4.1. Virtual Memory 4.2. Virtual Memory Segmentation 4.2.1. Virtual Memory Segmentation Examples 4.2.2. Descriptor Tables for Segments 4.2.3. Virtual Address Translation 4.2.4. Task Organization 4.2.5. Segment Descriptor Anatomy 4.2.6. Cache Registers for Segmentation 4.3. Paging Mechanism 4.3.1. Paging Fundamentals 4.3.2. Segment Paging Example		6 hrs
5. Protection Methods 5.1. Types of Protection 5.2. Memory Management and Protection 5.3. Multi-Level Privileges and Protection 5.4. Data and Programs Protection 5.5. Control Transfer between Protection Levels 5.6. Page Protection 5.7. Interrupts and Exceptions in Virtual (Protected) Mode 5.7.1. Definitions 5.7.2. Virtual Mode Interrupts 5.7.3. Interrupt Gates		6 hrs
6. Multitasking 6.1. Definitions 6.2. Task State Segment and the Related Descriptor 6.3. Task switching 6.4. Task Gate		4 hrs

Bibliography - C. Burileanu, "Arhitectura microprocesoarelor", Editura Denix, Bucureşti, 1994. - C. Burileanu s.a., "Microprocesoarele x86 – o abordare software", Ed. "Grupul microInformatica", Cluj-Napoca, 1999. - C. Burileanu, Lecture notes, available online on the faculty's „Moodle" platform.		
8.2 Practical applications	Teaching techniques	Remarks
An integrated development tool for 8051 core microcontrollers (IDE – „Integrated Development Environment")	The teacher presents briefly the theoretical concepts that will be used in the laboratory, and then guides the students to develop practical applications for the C8051F040 microcontroller. The teaching materials are the laboratory papers.	2 hrs
Overall view on Silicon Labs - C8051F040 „System on a Chip"		2 hrs
Application using the analog to digital converter		2 hrs
Application using the UART system		2 hrs
Application using the digital to analog converter		2 hrs
Application using the interrupts system		2 hrs
Laboratory assessment		2 hrs
Bibliography - C. Burileanu, H. Cucu, Laboratory papers, available online on the faculty's „Moodle" platform.		

9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

The course content is largely similar to that of courses with the same objectives taught in other universities in the European Union. The course content is continually updated and adapted after consultations with representatives from the business environment.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	- knowledge of fundamental theoretical issues; - solving typical, practical problems	Oral exam in the exam session: - Student's free presentation; - Evaluation discussion; - Oral questioning.	50%
10.5 Practical applications	- designing an algorithm for solving a typical problem; - translating the algorithm in a program written in 8051 assembly language; - demonstrating the correct execution of the 8051 program.	Two equally-graded, multiple choice verification tests (during the semester). Oral final evaluation to asses the implementation, debugging and execution of an application for the 8051 microcontroller.	50%

10.6 Minimal performance standard
- Knowledge of architectural attributes and addressing modes for microcontrollers and microprocessors; - Design, implementation and execution of a program written in 8051 assembly language.

Date
01.10.2017

Lecturer
Prof. Corneliu Burileanu

Instructor for practical activities
Asist. Diana Şandru

Director of Department,
Prof. Dr. Ing. C. Dan